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ABSTRACT

This paper outlines a senior seminar, or "capstone" course, in computer science developed at the University of South Carolina at Spartanburg. It was intended that the senior seminar should differ in classroom format from other courses in the major. Course requirements include timed oral presentations, reading of science fiction in which computers figure prominently, written responses to a videotape series, ethics exercises, programming assignments, and a comprehensive exam. This seminar provided students with a sense of achievement that "just taking a course" could never provide. Their sense of self esteem at having successfully completed the seminar was evident near the end of the semester. (BEW)

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Paper (M4-201A)

The Capstone of the C.S. Major

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Abstract

A course different from the norm is used to "cap" the undergraduate major. Students are required to present results of their research covering upper-level topics in computer science. Ethics exercises and a comprehensive examination are a significant part of this experience.

Background

In 1987, the faculty of the University of South Carolina at Spartanburg (USCS) passed a general education curricula that requires each baccalaureate major to provide a Senior Seminar course. The format of the course was open to interpretation by the faculty in each major area. It was decided by the computer science faculty that something other than an "ordinary" course would be appropriate. As a result, a research and presentation format was adopted. Over the years, the format has evolved to the present day course described below.

The course syllabus is as follows:

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	Grade Each		Final Grade
A-Talk (20 minutes)	100		
A-Paper	100	average to	100
B-Talk (45 minutes)	100		
B-Paper	100	average to	100
C-Talk (45 minutes)	100		
C-Paper	100	average to	100
Programming Exercise			100
Computer Science Fiction Book Report			50
Distinguished Lecture Series Video Report			
Two at	25 points each		50
Ethics in America Video Report			
Two at	25 points each		50
Comprehensive Examination			200
Ethics Self-Assessment Procedure questions:			
4 different at	50 points each		200
		Course Total	950

Rationale

Since the Senior Seminar course was identified as a separate category in the general education curriculum, it seemed that the course should not be the same classroom format as all of the other courses in the major. It could have been treated as a very advanced undergraduate course in which a topic of interest to the instructor is selected. Indeed, other major areas are treating this course in this manner. This methodology does not provide the student with as valuable an experience as requiring them to perform research and give speeches regarding this research.

A major precaution given the participants is that simple lectures belaboring material that they have covered in courses they have taken is not acceptable. The intent is that they may use their course work as a starting point to research areas that are not covered in these previous courses. Another warning is that unless the circumstances are very unusual, each presentation and paper must cover different subject areas. Only rarely has permission been given to have two presentations cover the same primary subject area; and this was generally to permit the introduction of a topic not covered in the curriculum, e.g. programming real-time system controllers, followed later by a long talk relating more advanced aspects.

The Presentations

All student presentations are timed. Presenters are required to deliver one twenty minute talk and two forty-five minute talks. They are penalized for not fulfilling their time requirements. Class periods are normally 50 minutes, so there is an intent to elicit questions at the end of the presentation.

They are permitted to use any audio-visual aids that they see fit. However, if they spend too much time on video tapes, they are penalized for time, just as though they didn't speak long enough. This is a judgment decision by the instructor.

A calendar is given to the students at the beginning of the semester showing the dates of all talks. The talks are indicated as A1, A2, ..., A12 (for a class of 12 students); B1, B2, ..., B12; and C1, C2, ..., C12 on the calendar. The students randomly draw pieces of paper for each talk category to ascertain when their "turn" is. Each talk is drawn separately. The only difficulty with this is that it is possible for a student to have two talks relatively close together. The only circumstance where they are allowed to throw the selection back is if they draw back-to-back talks, e.g., say A12 and B1. These are essentially back-to-back even though there may be other activities between the actual presentation days.

The "A" talk consists of one twenty minute talk. Two students can make these presentations in one class period. The idea here is to get them started doing research on a topic and presenting their results without having an overwhelming amount of preparation. This is a "practice run" in that it is graded somewhat leniently. At the completion of the talk, the speaker is required to turn in a research paper from which the talk was drawn.

The "B" and "C" talks consists of two forty-five minute presentations. This requires extensive research on their part. Since this activity is something the students do infrequently, it initially requires a great deal of time and effort on their part. The intent of the course is to introduce them to intense research, report writing, and presentation. At the completion of each talk, the speaker is required to turn in a research paper from which the talk was drawn.

All of the students enrolled in the course are required to fill out an evaluation form for each talk. A copy of the form is shown as Appendix A. If any visitors come to the talk, they are permitted to fill out an evaluation form if they would like. To ensure that the speaker doesn't bring a large number of friends solely to give high marks on the talk, a formula is used to weigh the students' and visitors' evaluation marks against the instructor's evaluation marks. Currently two scores, the average of all of the student and visitor evaluations and the instructor's evaluation, are used in a weighted formula to produce the final grade for the talk.

Both the papers and the presentations are graded on a one hundred point scale. Then the grades for the presentation and for the paper are averaged together to produce a one hundred point basis for that endeavor.

Science Fiction Books

There is a genre of science fiction works in which the computer is a central part. It was felt that having the students read at least two books would provide a different viewpoint than they will get in their course work. The suggested reading list is provided as Appendix E. Many students do not read works of fiction today, so perhaps this introduces them to another form of entertainment.

Two days are usually set aside during which the science fiction books are discussed. All students must state which books they read. Then, each student gives a brief summary of the book(s) that she or he read. The intent is to have an open discussion about the possibilities of computers becoming "intelligent", or taking over the world, or whatever topic is of interest to the group.

A written book report is required of each of the students. They may report on one or both of the books. The book reports are usually only graded for truthfulness, grammar, syntax, and spelling. The essence of this is that they are permitted to report on their perspective of the book(s), not what the instructor expects to hear about the book(s). No particular book report format is required.

C.S. Distinguished Lecture Video Tapes

The Distinguished Lecture Series[2] of videotapes is a superlative collection of videotapes related to "Forward thinking and development" of topics related to computer science. Each tape has a single theme, and the speaker describes details about her/his topic. The students are required to view at least two video tapes and to produce a written report on each tape. The format for the report is seen in Appendix B. They are encouraged to view these tapes as soon as they can. The tapes have proven to be good resource material for their presentations and papers. The students report on their perspectives of what they have viewed. The written reports are graded for syntax, grammar, and spelling.

Ethics In America Video Tapes

All computer science majors at USCS are required to take a junior level ethics course offered by the philosophy department as part of their general education requirements. Several years ago, PBS ran a series of panel discussions entitled "Ethics in America"[1]. These eleven discussions are available on videotape in the USCS library. To supplement their ethics training, the senior seminar students are required to view at least two of these videotapes and produce a written report on each of them. The students have raved about this videotape series. Often, they state that they have viewed three or four of the tapes. None of the topics relate to computer science; they do relate, however, to real world scenarios, and consequently they are extraordinarily interesting. The students report on their perspectives of what they have viewed. The written reports are

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graded for syntax, grammar, and spelling. The report format is the same as for the other videotape requirement and is seen in Appendix B.

Ethics Self-Assessments

In November 1990 CACM [4] ran a "Self-Assessment Procedure" related to ethics and ethical considerations in the computer environment. Fifteen scenarios are available along with panel responses. The students are not informed that these scenarios are available in CACM[4]. The intent is that they work the ethics issues out themselves.

Four different scenarios are given to the students as a take-home exercise. The written reports from the students must follow the format given in Appendix C. These exercises are graded leniently, with points being deducted for syntax, grammar, and spelling. These are used as a continuation of the student's ethics training with an emphasis on the relationship of ethics to the computer industry.

Programming Exercise

One of the goals of the computer science major is to produce graduates who are able to function as commercial programmers (as opposed to sending them to graduate school as another possibility). Consequently, it was felt that each student about to graduate should demonstrate her or his ability to write computer programs.

Impartiality and balance in programming exercise subjects is achieved by having problem statements submitted by the faculty. One of the submitted problems is then agreed upon by the faculty that desire to participate in this exercise (not all faculty choose to participate in this exercise).

To prevent students from spending too much time on the programming exercise, a time limit is established. The programming exercise assignment statement has been given to the students in two ways: as a developed algorithm or as a narrative problem description. Since this is an exercise in programming, the author prefers providing an algorithm. Hence, this truly becomes a "coding" exercise rather than a problem solving exercise. The problem solving comes in the Comprehensive Examination discussed later. Experience has shown that particularly evening students who only take one or two courses per semester find this exercise troublesome. This mostly affects students who have not been enrolled in programming courses recently, or who are not working in a programming environment.

The programming languages permitted for this exercise are Modula-2 (the language used in most courses), C, and Ada. At this time, the only language provided by the campus is Modula-2. If the student uses any other language, she or he must provide it.

Comprehensive Examination

The instruction page for the Comprehensive Examination is shown as Appendix D. This provides for five questions worth forty points each.

The first question, "Simple Algorithms", is given as a "take home" test with an honor system time limit. This embodies problem solving by developing an algorithm. This is a principal aspect of the first course in the major. The second question, "Complex Algorithms", covers materials from the second course in the major. This continues the problem solving and algorithms as well as elementary data structures. The third question, "Data Structures", encompasses all aspects of a formal data structures course.

The topics covered on the other two questions include: "File Management", "Computer Organization & Architecture", "Program Design (Software Engineering)", "Database Management", "Operating Systems", "Programming Languages", "Discrete Mathematics", and "Numerical Analysis." Students in the Applied Math Concentration may take "Discrete Mathematics" or "Numerical Analysis", but not both. All of the questions are created and graded by the computer science or mathematics faculty.

The students use a code name on the answer sheets they write their responses on. Consequently, unless the student has a very unique handwriting, people grading the questions do not know whose test they have. It may or may not make any difference to the faculty, but the students feel that this "blind grading" is better.

Other Aspects of the Course

During the first few weeks of the semester, faculty members are given the opportunity to make presentations to the senior seminar students. The faculty member chooses the topic and makes a formal presentation in a fifty minute period or whatever part of the period they choose to use. This introduces the students to the idea of formal presentations and being able to defend their ideas.

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If no faculty or not enough faculty choose to make presentations, then one or more of the Distinguished Lecture Series[2] are shown to the students. If video tapes are shown, the students are not permitted to submit those titles as a tape they have reviewed. The Alan Kay tape, "Doing With Images Makes Symbols" is the first choice when video tapes are used. The second choice has been the Seymour Cray tape "What's All This About Gallium Arsenide?"

The newest facet of the Senior Seminar course is to invite alumni to come to the class. Usually, not more than four alumni are invited to attend a class. They are requested to discuss (briefly) what kind of work they are currently doing, what aspects of their course work at USCS was most beneficial, and what aspects of their course work at USCS was least beneficial. The alumni have provided some useful and interesting insights to the computer science program.

Summary

The Senior Seminar course has become a matter of pride among the computer science faculty and the students that have completed the course. The faculty realize that this course advances the students beyond the level of the majority of other students graduating from USCS. The students perceive a sense of accomplishment.

The programming exercise and the comprehensive examination give excellent feedback to the faculty on weaknesses in the curriculum. They also show strengths in the major. This information is used as the primary component of assessment reporting currently required at this institution. Weaknesses are reported along with proposed changes to make the curriculum better. Strengths are reported praising the accomplishments of the students and the faculty.

Upon completion of such a rigorous course, the students will better know what their strong and weak points are. In the job interview process, they can emphasize their strong points and attempt to correct their weak points.

When students ask questions in class, they are attempting to clarify an area that they do not understand. When they have to make complete presentations that are coherent, meaningful, technical, and interesting, they are going way beyond what they normally do in class. In addition, they discover a great deal about themselves.

This experience provides a sense of achievement that just "taking a course" can never provide. Their sense of self-esteem at having successfully completed this course is evident near the end of the semester. It is even more conspicuous for students who must return in the Fall Semester to fulfill other course requirements. Their comments to students often take the tone of one who has been initiated versus one who has not.

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